JUDGE RAKOFF

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07 CV 3529

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

MAY 02 2007

MARTIN PROFESSIONAL A/S and MARTIN PROFESSIONAL, INC.	Case No. 07 Civ. ____
Plaintiffs,	
- against -	COMPLAINT AND JURY DEMAND
ROBE SHOW LIGHTING S.R.O. and ROBE AMERICA, LLC	
Defendants.	

Plaintiffs Martin Professional A/S and Martin Professional, Inc. (collectively "Martin" or "Plaintiffs"), by their attorneys Skadden, Arps, Slate, Meagher & Flom LLP for their Complaint against Defendants Robe Show Lighting s.r.o. and Robe America LLC (collectively "Robe" or "Defendants") allege upon knowledge with respect to their own acts, and upon information and belief as to other matters, as follows:

THE PARTIES

1. Plaintiff Martin Professional A/S is a Danish corporation having its principal place of business at Olof Palmes Allé 18, DK-8200 Århus N, Denmark. Martin Professional A/S is in the business of, among other things, designing, manufacturing and selling sophisticated lighting products for use in entertainment, architectural and display environments.

2. Plaintiff Martin Professional, Inc. is a Florida corporation having its principal place of business at 700 Sawgrass Corporate Parkway, Sunrise, FL 33325. Martin Professional, Inc. is in the business of distributing, marketing, selling, and providing technical training and support in the United States for, among other things, the sophisticated lighting products designed and manufactured by Martin Professional A/S.

3. Upon information and belief, Defendant Robe Show Lighting s.r.o. is a Czech Republic company having its principal place of business at Házovice 2090, 756 61 Rožnov pod Radhŏstĕm, Czech Republic.

4. Upon information and belief, Defendant Robe America, LLC is a Florida limited liability company having its principal place of business at 5299 N.W. 108th Avenue, Sunrise, FL 33351-8070.

JURISDICTION AND VENUE

5. This action arises under the patent laws of the United States, 35 U.S.C. § 101, *et seq.* This Court has jurisdiction over the claims asserted herein pursuant to 35 U.S.C. §§ 1331 and 1338(a).

6. This Court has personal jurisdiction over Robe because Robe regularly conducts business within this judicial district and has committed acts of patent infringement within this judicial district.

7. Venue is proper in this Court under 28 U.S.C. §§ 1391(b) and (c) and 1400(b) because Robe resides in this judicial district by virtue of conducting regular and substantial business in this judicial district.

COUNT I
(Infringement of United States Patent No. 6,601,973)

8. Martin Professional A/S is the sole and exclusive owner of United States Patent No. 6,601,973 to Niels Jørgen Rasmussen and Mads Glavind ("the '973 patent"). The '973 patent, entitled "Light Effects System", was duly and legally issued by the United States Patent and Trademark Office on August 5, 2003. A true and correct copy of the '973 patent is attached hereto as Exhibit A.

9. In violation of 35 U.S.C. § 271, Robe has made, used, offered for sale, sold and/or imported in or into the United States lighting devices and/or parts thereof that infringe one or more claims of the '973 patent, including but not limited to the ColorSpot product line.

10. Robe's infringement of the '973 patent has occurred with knowledge of the '973 patent, and thus has been willful.

11. Martin has suffered and will continue to suffer serious and irreparable injury unless Robe's infringement of the '973 patent is preliminarily and permanently enjoined.

COUNT II
(Infringement of United States Patent No. 6,971,770)

12. Martin Professional A/S is the sole and exclusive owner of United States Patent No. 6,971,770 to Niels Jørgen Rasmussen and Mads Glavind ("the '770 patent"). The '770 patent, entitled "Light Effects System", was duly and legally issued by the United States Patent and Trademark Office on December 6, 2005. A true and correct copy of the '770 patent is attached hereto as Exhibit B.

13. In violation of 35 U.S.C. § 271, Robe has made, used, offered for sale, sold and/or imported in or into the United States lighting devices and/or parts thereof that infringe one or more claims of the '770 patent, including but not limited to the ColorSpot product line.

14. Upon information and belief, Robe's infringement of the '770 patent has occurred with knowledge of the '770 patent, and thus has been willful.

15. Martin has suffered and will continue to suffer serious and irreparable injury unless Robe's infringement of the '770 patent is preliminarily and permanently enjoined.

PRAYER FOR RELIEF

WHEREFORE, Martin respectfully requests that this Court enter judgment in its favor and against Robe and grant the following relief:

A. A judgment that Robe has infringed the '973 and '770 patents in violation of 35 U.S.C. § 271;

B. A judgment that Robe's infringement of the '973 and '770 patents has been willful;

C. Preliminary and permanent injunctive relief, pursuant to 35 U.S.C. § 283, enjoining Robe and all persons in active concert or participation with Robe, from any further acts of infringement of the '973 and '770 patents;

D. An order, pursuant to 35 U.S.C. § 284, awarding Martin damages adequate to compensate for Robe's infringement of the '973 and '770 patents, in an amount to be determined at trial, but in no event less than a reasonable royalty;

E. An order, pursuant to 35 U.S.C. § 284, trebling all damages awarded to Martin in view of Robe's willful and wanton infringement of the '973 and '770 patents;

F. An order, pursuant to 35 U.S.C. § 284, awarding to Martin interest on the damages and its costs incurred in this action;

G. An order, pursuant to 35 U.S.C. § 285, finding that this is an exceptional case and awarding to Martin its reasonable attorneys' fees incurred in this action; and

H. Such other and further relief as this Court may deem just and proper.

JURY DEMAND

In accordance with Fed. R. Civ. P. 38 and 39, Plaintiffs assert their right under the Seventh Amendment of the United States Constitution and demand a trial by jury on all issues so triable.

Respectfully submitted,

Dated: May 2, 2007

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Exhibit A

US006601973B2

(12) **United States Patent**
Rasmussen et al.

(10) **Patent No.: US 6,601,973 B2**
(45) **Date of Patent: Aug. 5, 2003**

(54) **LIGHT EFFECTS SYSTEM**

(75) Inventors: **Niels Jorgen Rasmussen**, Arhus C (DK); **Mads Glavind**, Hobro (DK)

(73) Assignee: **Martin Professional A/S** (DK)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/892,083**

(22) Filed: **Jun. 26, 2001**

(65) **Prior Publication Data**

US 2002/0075685 A1 Jun. 20, 2002

(30) **Foreign Application Priority Data**

Jun. 26, 2000 (DK) 2000 00995

(51) **Int. Cl.**[7] **F21V 9/00**; F21V 29/00

(52) **U.S. Cl.** **362/282**; 362/293; 362/322; 362/373

(58) **Field of Search** 362/284, 293, 362/324, 319, 340, 322, 282, 373, 552, 583, 300, 326, 811; 353/97; 359/813, 814, 889

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,392,187 A		7/1983	Bornhorst	362/233
4,460,943 A		7/1984	Callahan	362/276
4,827,387 A	*	5/1989	Ferren et al.	362/284
4,891,738 A		1/1990	Richardson	362/282
4,984,143 A	*	1/1991	Richardson	362/293
5,402,326 A		3/1995	Belliveau	362/284
5,779,353 A	*	7/1998	Kacheria	362/293
5,823,661 A	*	10/1998	Mahanay et al.	362/293
6,152,577 A	*	11/2000	Rizkin et al.	362/293
6,224,248 B1	*	5/2001	Chiba	362/580

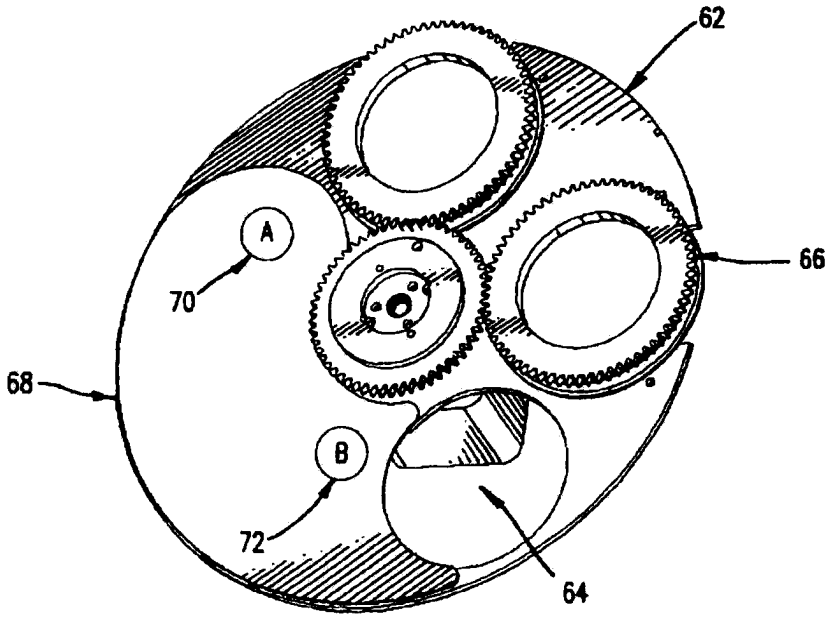
* cited by examiner

Primary Examiner—Y. My Quach-Lee
Assistant Examiner—Peggy A. Neils
(74) *Attorney, Agent, or Firm*—Skadden, Arps, Slate, Meagher & Flom LLP

(57) **ABSTRACT**

A light effects projector includes a light source and effect wheels interposed between the light source and an exit aperture of the projector. A gobo wheel includes a plurality of apertures and gobo holders containing gobos. The gobo wheel is adapted to rotate so as to place a gobo, which is retained in one of the holders, within the light path from the light source. The gobo holders of the gobo wheel are removably secured to the gobo wheel by a spring retainer that engages flange portions of a gobo holder. The projector further includes a cooling system to cool the gobos during operation. Additionally, the projector includes an effects wheel that provides a "frost effect" portion to variably distort light from the projector.

14 Claims, 9 Drawing Sheets



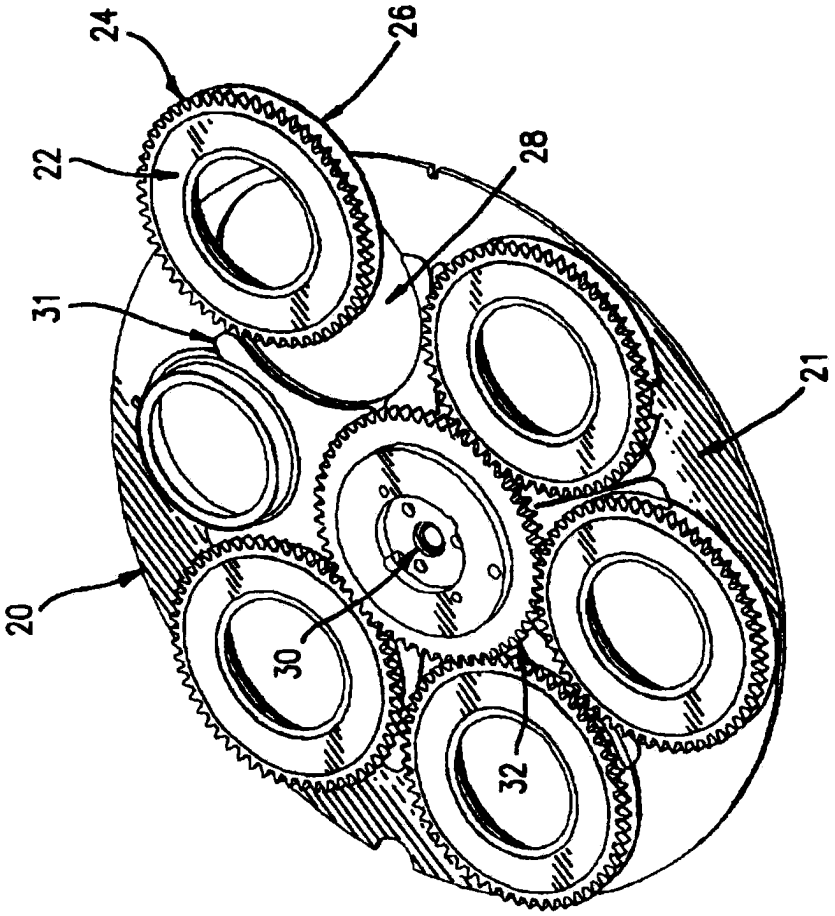


FIG. 1A

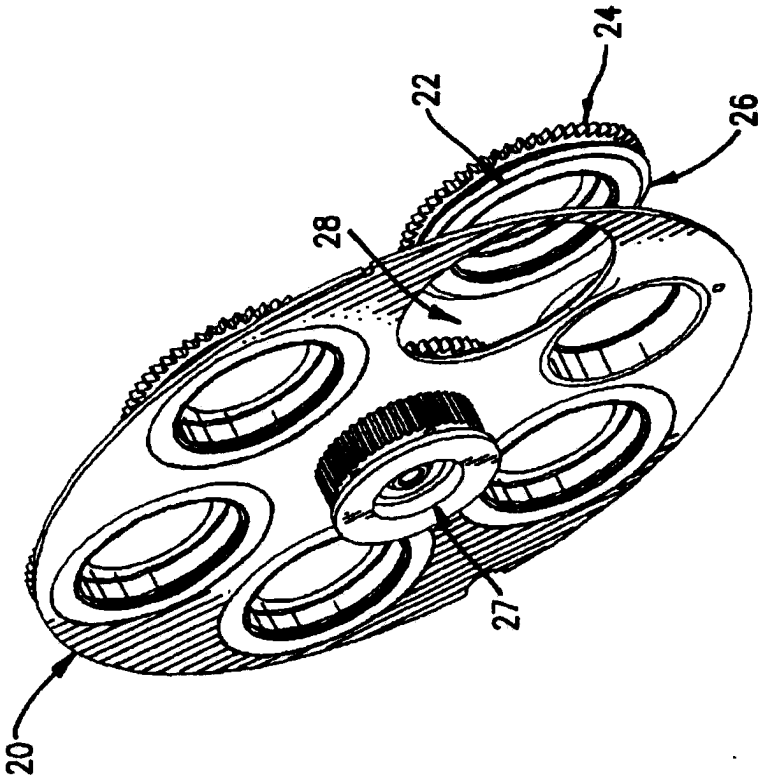


FIG. 1B

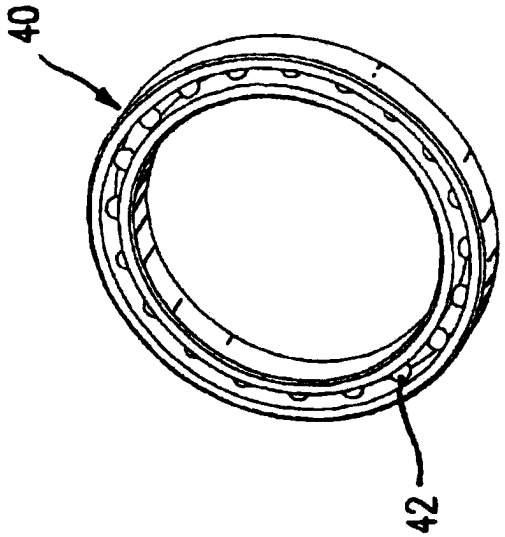


FIG.2B

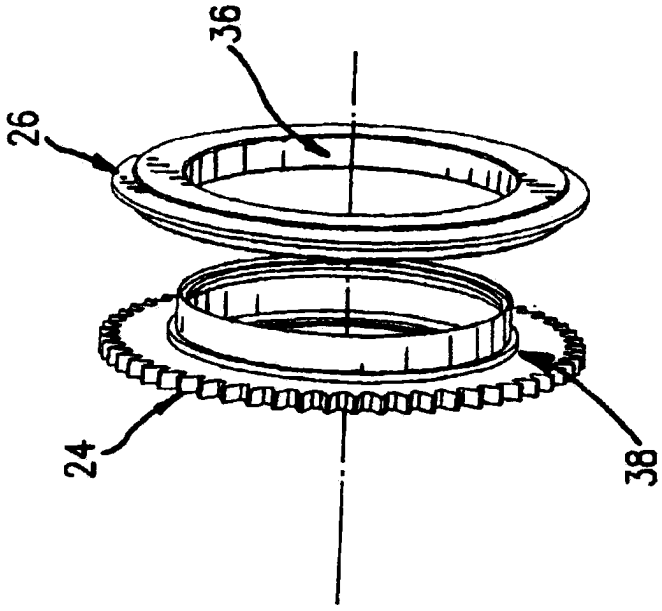


FIG.2A

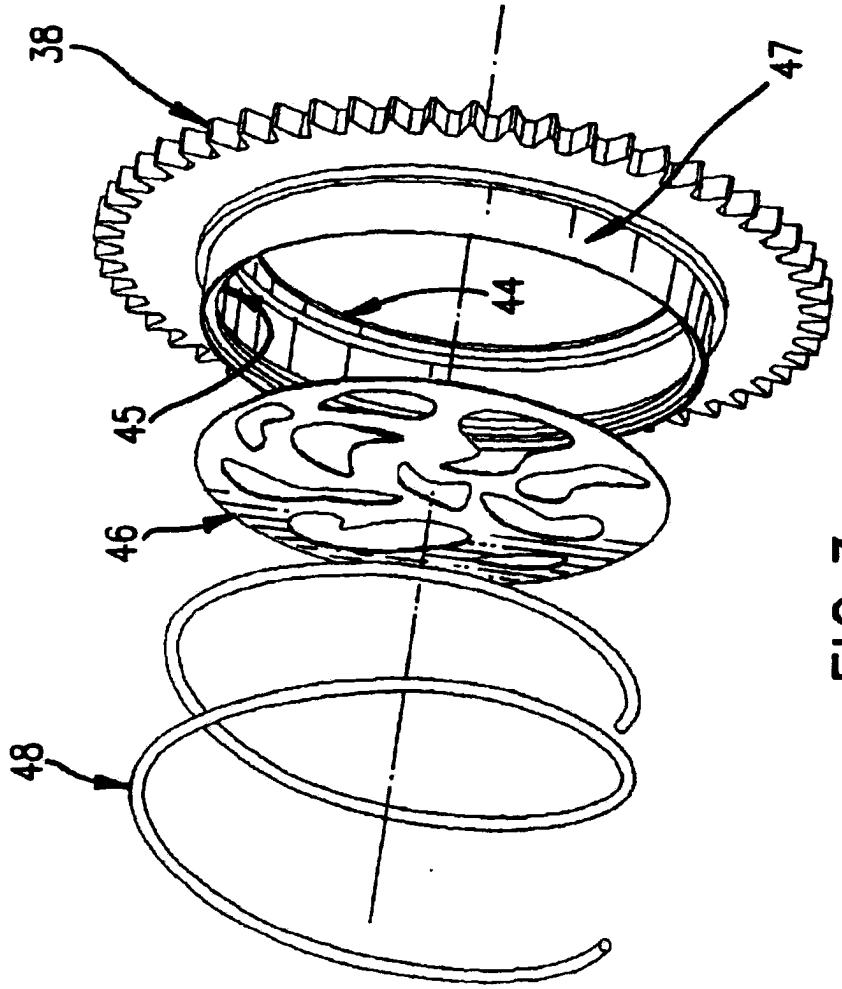


FIG.3

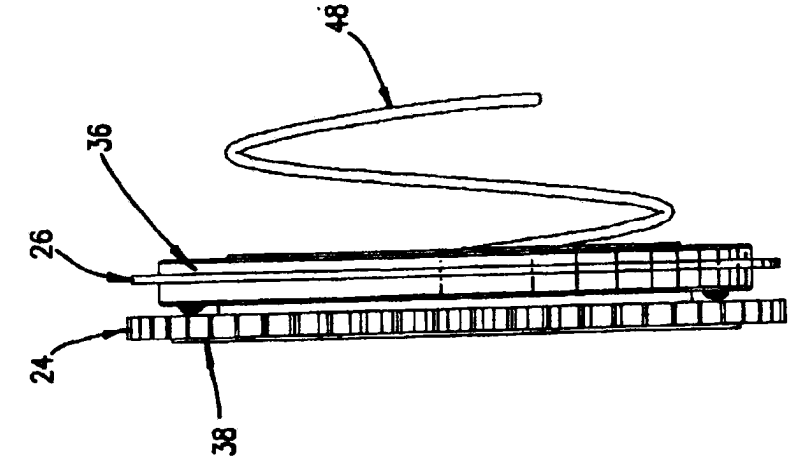


FIG.4B

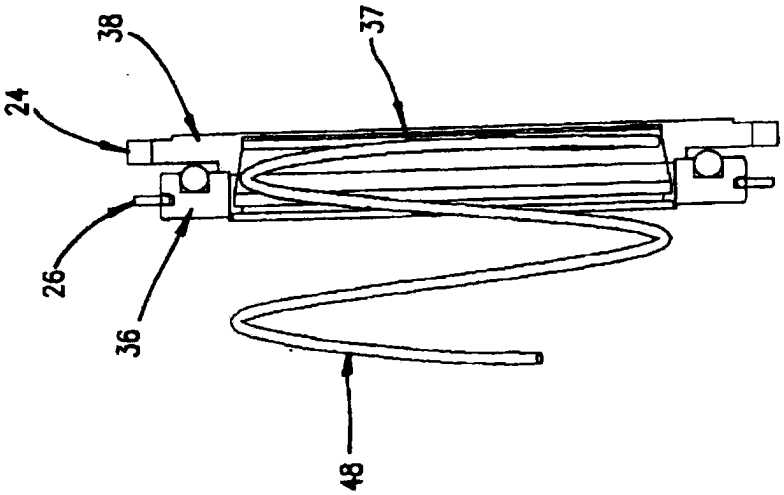


FIG.4A

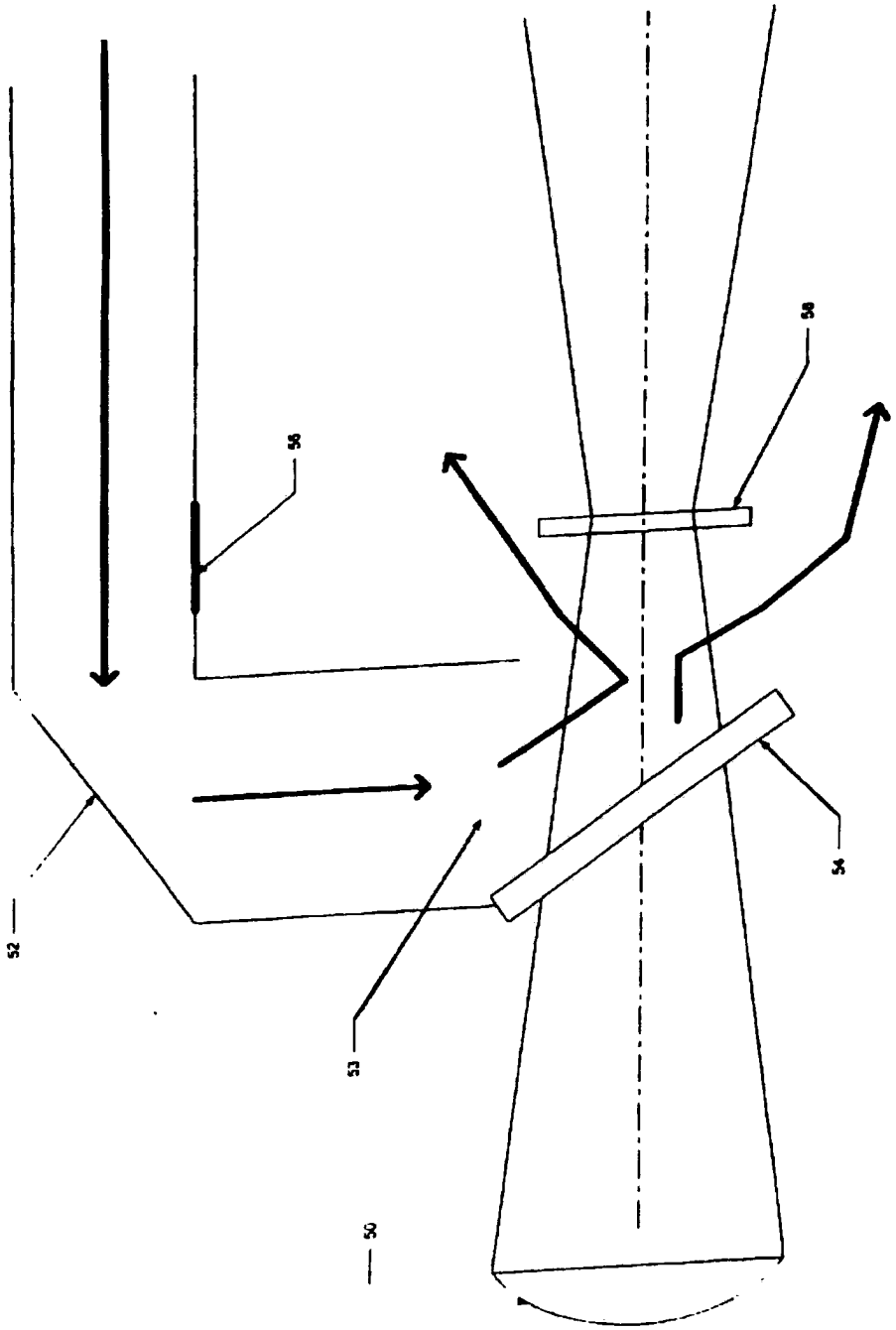


Figure 5A

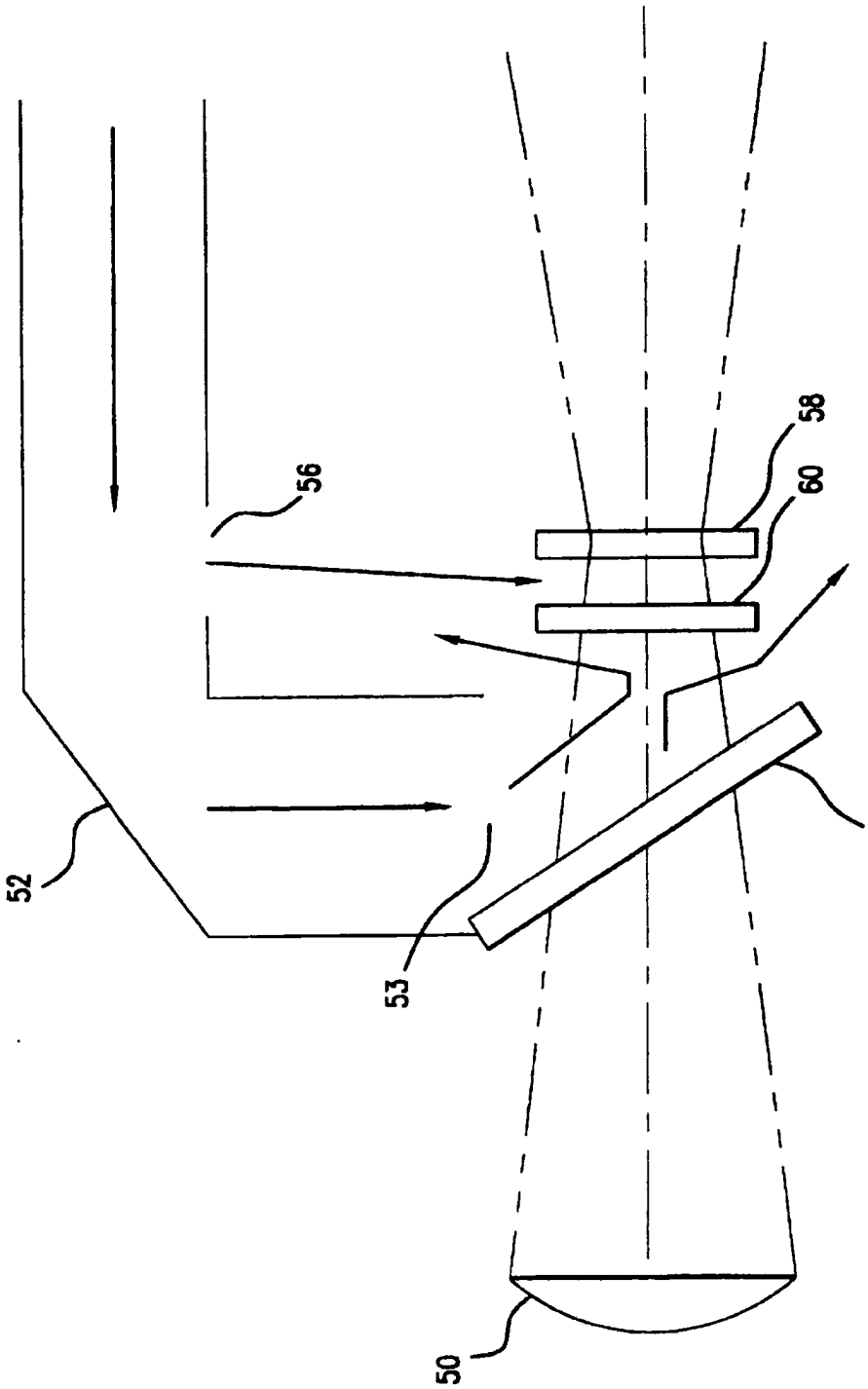


FIG.5B

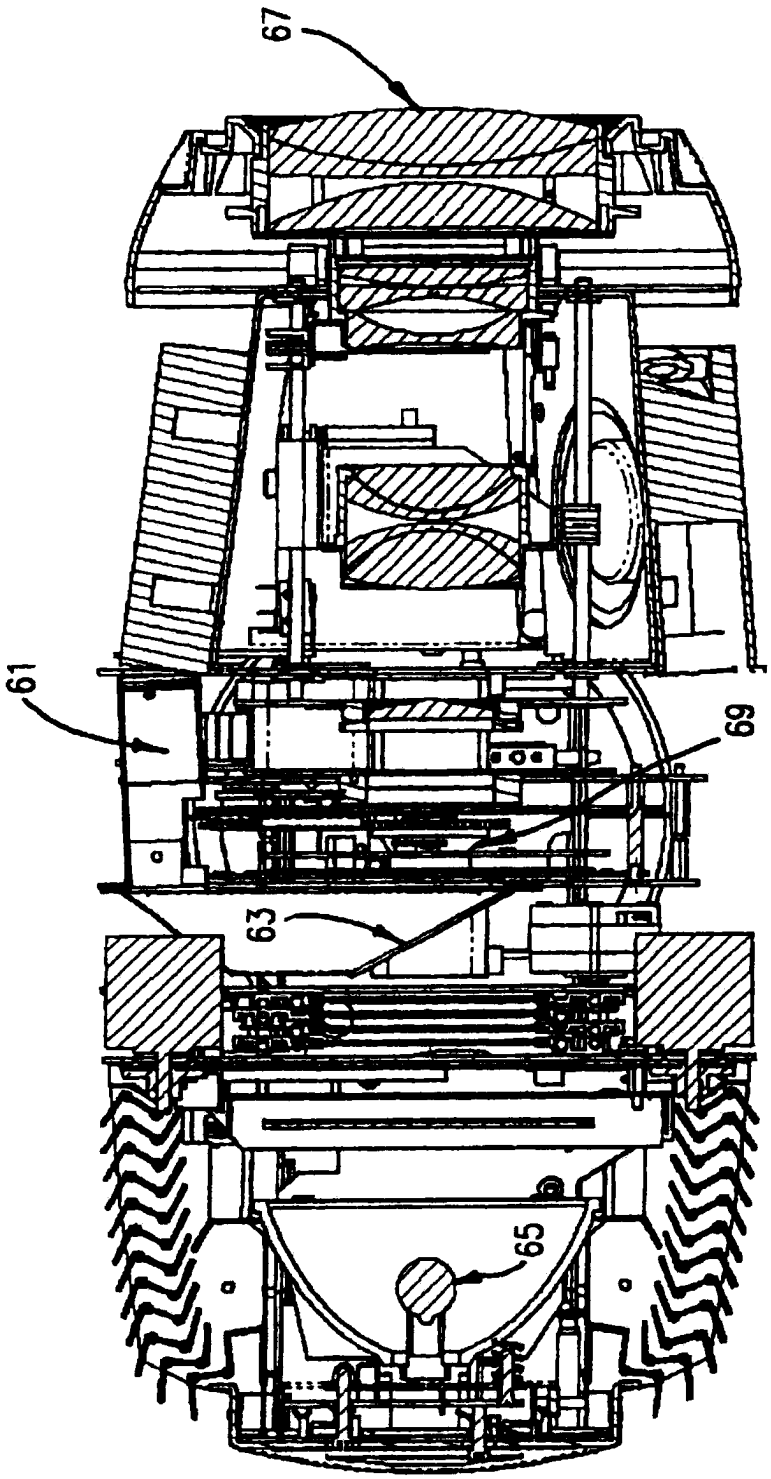


FIG.5C

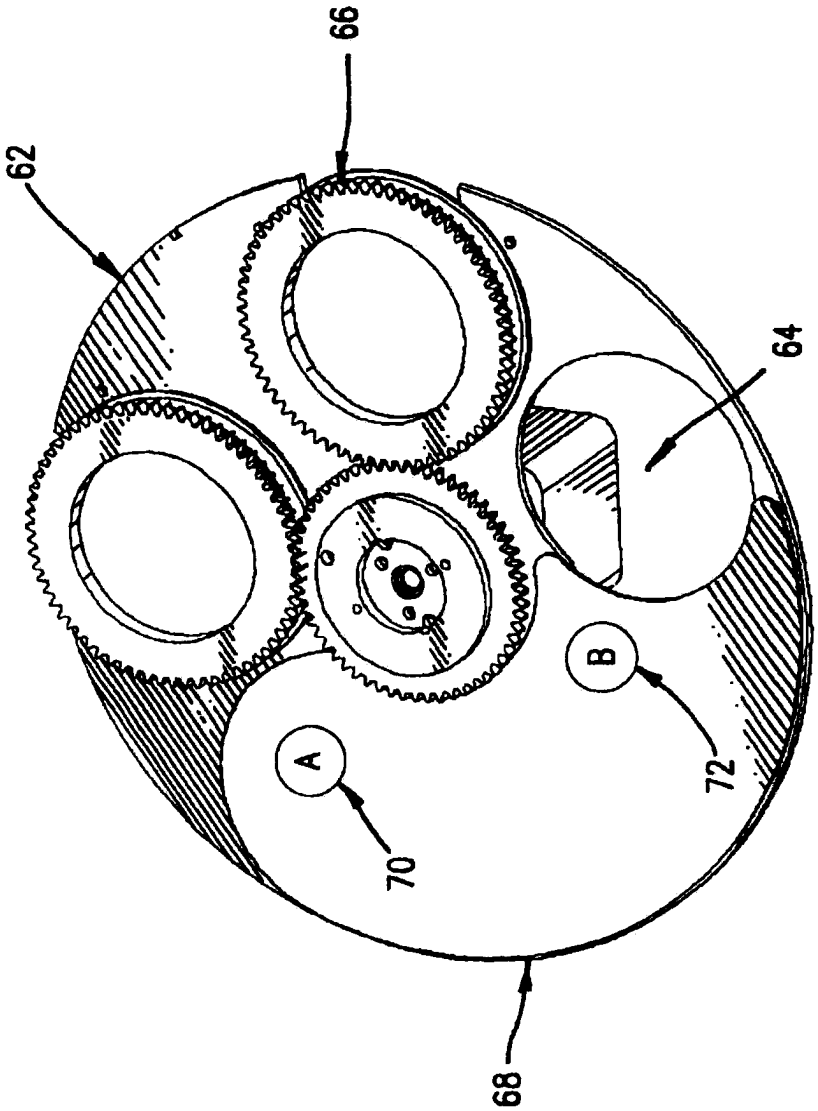


FIG.6

LIGHT EFFECTS SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit, under 35 U.S.C. §119, of Danish Patent Application No. PA2000 00095, entitled "Effects modules and combinations thereof to produce a variety of lighting effects," filed Jun. 26, 2000.

FIELD OF THE INVENTION

The present invention relates to automated lighting systems for use in entertainment, promotional, and architectural applications. Particularly, the invention relates to manipulating a light beam from such projectors to produce lighting effects.

BACKGROUND

Conventional projectors for stage, theater, architectural, and display illumination include means for removably inserting various types of optical beam modifiers into the path of a light beam to vary the color, intensity, size, shape, and pattern of the beam. Thus, in a typical system, a light source produces white light which is passed, for example, through at least one color filter wheel for producing a colored light beam, a gobo wheel for imposing a selected pattern on the light beam, a light intensity wheel for varying the intensity of the light transmitted therethrough, a mechanical iris for determining beam size, and a lens system for controlling light beam focus and divergence. U.S. Pat. No. 4,392,187 to Bornhorst discloses several such systems.

For imposing a desired pattern on the light beam, it is well known to pass the beam through a gobo, which is a template or light stencil having a predetermined pattern. Typically, gobos are formed by chemically etching the desired pattern onto stainless steel discs. The gobos discs are usually supported in the projected light beam to impose upon the light passing therethrough the pattern which has been etched into the discs. It is well known, for example from U.S. Pat. No. 4,460,943 to Callahan, to provide a mounting plate having a plurality of equally spaced apertures arranged around a common axis for mounting gobos within one or more of the apertures. The plate is drivingly rotatable, such as via a motor, about its axis to insert a selected gobo into the path of the beam of light. U.S. Pat. No. 4,891,738 to Richardson discloses a similar arrangement including an apertured gobo mounting plate which is rotatably driven by motor driven rollers frictionally engaging the peripheral edge of the plate. The gobos are mounted on or within holders which, in turn, are fixedly positioned within the plate apertures. The mounting plate is rotatably driven to position a selected gobo within the beam of light. After reaching this position, a motor-operated holder drive mechanism acts, through frictional contact with the rim of the holder, to rotatably drive the gobo holder in either direction at various speeds. In this manner, the plate is rotatable to position a selected gobo within the beam of light and the gobo holder is rotatable to spin the gobo holder within the beam of light.

Generally, the projectors are constructed in a compact fashion because the rotational inertia of the projector increases the speed at which the beam of light can be moved into position. This compact design leads to various disadvantages in the maintenance and upkeep of the projectors. Furthermore, the compact design of the projectors hinders the replacement of gobos in the projector.

For example, U.S. Pat. No. 5,402,326 to Belliveau discloses a gobo carousel that contains a number of gobo holders. The carousel is rotatable to position a desired gobo within the light path and further includes means for rotating the holders relative to the carousel itself. The holders are permanently attached to the carousel and include a mechanism for securely retaining and for replacing gobos from within the holders. However, due to the compact design of the light projector, such gobo carousels, as well as the gobo holders, are often mounted in close proximity to adjacent mechanical parts. Accordingly, replacing the gobos in the gobo holders can be very awkward. Therefore, there is a need for a system that enables easy exchange of the gobos in such compactly constructed projector.

Another problem related to the compact design of the projector is thermal management. In high intensity versions of such projectors, the interception of the light beam by gobos leads to a build up of heat. If this heat is not sufficiently managed, deterioration and even destruction of the gobos can result. In order to keep the gobo within necessary operating temperature ranges while intercepting the light beam, an appropriate thermal management system should be employed. Therefore, there is a need for a compact system for facilitating the thermal management of the gobos. Additionally, when projecting light onto a subject, it is often desirous to blur the image, which is known as a "frost effect." The frost effect is typically provided by a pair of opposed flags that partially intercept the beam, the extent thereof providing a variable degree of frost. However, such frost effect systems are difficult to maintain and configure in compact projectors. Therefore, there is a need for a convenient and easily configured system for providing image frost effects.

SUMMARY OF THE INVENTION

The present invention provides a system and method for easily replacing gobos in a compact projector by providing rotatable gobo holders that are adapted to be easily removed from and reattached to the permanently mounted gobo carousel. In accordance with one aspect of the invention, a gobo wheel assembly is provided including a rotatable base plate, a gobo holder, a spring retainer adapted to removably couple the gobo holder, and a central sun gear.

There is further provided a gobo cooling system including an air flow and a window positioned within the light path in the projector. The window is positioned within the air flow to deflect air to a gobo.

Additionally, there is provided an effects wheel including a rotatable baseplate and a transparent frost filter forming a portion of the baseplate for creating frost effects.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a front perspective view of a gobo wheel in accordance with the invention;

FIG. 1B is a back perspective view of the gobo wheel of FIG. 1A;

FIG. 2A illustrates a gobo retainer and a bearing housing of a gobo holder in accordance with the invention;

FIG. 2B illustrates a bearing of a gobo holder in accordance with the invention;

FIG. 3 illustrates a gobo retainer as well as a gobo and corresponding spring;

FIG. 4A is a first detail view of a gobo holder with a gobo secured therein;

FIG. 4B is a second detail view of a gobo holder with a gobo secured therein;

FIG. 5A illustrates a first embodiment of a gobo cooling system in accordance with the invention;

FIG. 5B illustrates a second embodiment of a gobo cooling system in accordance with the invention;

FIG. 5C illustrates a gobo cooling system of the invention in a projector assembly; and

FIG. 6 illustrates an effect wheel with a frost effect in accordance with the invention.

DETAILED DESCRIPTION

As general background, a description of an exemplary projector of the art is provided below. However, as may be appreciated, projectors in accordance with the invention include various other components and configurations. A projector of the prior art usually includes a light beam that emanates from a light source at a first end of the projector. The beam passes through a series of lenses and color filters before reaching the projector's gobo wheel. The gobo wheel is generally a single, drivingly rotatable wheel having multiple patterns etched therein and distributed about its outer periphery. In some projectors, a motor operated iris increases or decreases beam size before the beam encounters a motor operated effects wheel, which includes appropriate inserts mounted in peripherally distributed window apertures for creating desired modifying effects on the beam, such as altering beam pattern, color or diffusion, creating a prismatic effect, and the like. Finally, the projector may pass the light beam through one or more lenses for providing a zoom effect and for adjusting beam focus and/or divergence prior to exiting the projector housing.

FIG. 1A illustrates a rotatable gobo wheel assembly **20** in accordance with the invention. The gobo wheel assembly **20** includes a circular gobo baseplate **21** for supporting a plurality of gobo holders **22**. In the illustrated embodiment, the baseplate **21** includes six apertures **28** extending therethrough and positioned around, and equally spaced from, a central axis of the baseplate **21** for receiving respective gobo holders **22**. The baseplate **21** also includes a central hub **30** extending outwardly from one surface of the baseplate for attachment to a rotatable shaft of a motor (not shown) for rotating the baseplate to position one of the gobo holders **22** in the light path.

A spring retainer **31** is attached to the baseplate. A central sun gear **32** is coupled to a gear motor by a rotatable shaft (not shown). In this manner, the gear motor rotates with the entire gobo baseplate **21** while the sun gear **32** is able to rotate independent of the rotation of baseplate. In a typical fashion, sun gear **32** teeth formed on the peripheral edge of the sun gear engage complimentary to other portions **24** formed on the outer periphery of each gobo holder **22** for rotating the gobo holders upon rotation of the sun gear.

The spring retainer **31** is adapted to removably couple the gobo holders **22** to the baseplate **21**. Specifically, the gobo holders **22** are retained in place by the spring retainer **31**, which engages a circular flange **26** in the gobo holder.

FIG. 1B is a perspective view of the back of the gobo wheel **20** of FIG. 1A. As may be appreciated, the gobo holder **22** is adapted to removably couple to the spring retainer, so as to align the gobo holder opening with the baseplate aperture **28**. The baseplate **21** is fixedly coupled to a center rotation gear **27** that is adapted to facilitate the rotation of the gobo wheel by engaging with a motor gear to selectively provide an aperture **28** in the light path of the projector.

The gobo holder **22** is formed from two main parts, a toothed gear gobo retainer **38** and a bearing assembly **36**.

FIGS. 2A and 2B illustrate components of the gobo retainer and bearing assembly. A bearing ring **40** is formed from a pair of concentric rings, each including inward facing circumferential flanges, and a plurality of ball bearings **42**, which are interposed between the flanges of the concentric rings. As may be appreciated, the ball bearings **42** allow for each ring to rotate relevant to the other ring about the common center axis. The bearing ring **40** fits inside a bearing housing to provide a bearing assembly **36** whereby the inner cylindrical portion of the bearing assembly, as defined by the inner ring of the bearing ring, is rotatable with respect to the outer portion of the bearing assembly. The bearing assembly is fixed over the gobo retainer **38** by the inner cylindrical portion of the bearing assembly engaging the outer cylindrical portion of the gobo retainer. Accordingly, the gobo retainer **38** is rotatable with respect to the outer portion of the bearing assembly. The bearing assembly fits into an appropriately sized aperture **28** in the baseplate **21** and provides the mounting point for the circular flange **26** on the outer portion of the bearing assembly by which the gobo holder **22** couples to the baseplate.

FIG. 3 illustrates a gobo retainer **38** as well as associated gobo and spring. The gobo retainer **38** includes a cylindrical portion **47** having a first end and a second end. An annular land **44** defines an aperture in the first end. An overhang **45** is provided in the inner circumference of the cylindrical portion near the second end. The spring **48** is preferably a conical spring tapering to a minimum inner diameter that is generally greater than the diameter of the gobo retainer aperture. Accordingly, the spring portion that extends from the gobo retainer **38** is relatively large, allowing convenient manipulation of the spring within the gobo retainer **38**.

FIG. 4A illustrates a detail view of a gobo holder of the invention when securing a gobo **37** therein. As may be appreciated, the flange **26** of the gobo holder extends generally perpendicular to the center axis of the gobo holder. The toothed portion **24** of the gobo holder extends generally parallel to the flange **26**. The gobo retainer **38** is coupled to the inner cylindrical portion of the bearing assembly **36**, as discussed above. When the gobo holder **22** is secured in the gobo wheel **20**, the spring **48** is compressed within the gobo retainer **38** such that the spring does not extend outside the plane defined by the back opening of the gobo holder. Preferably, the gobo retainer **38** and the bearing assembly **36** are coupled together by placing the gobo retainer inside the bearing assembly and deforming the edge of the gobo retainer near its second end to couple to the inner cylindrical portion of the bearing assembly. In another embodiment, slide bearings are used in the bearing assembly to allow for the concentric rotation between the gobo retainer **38** and the bearing assembly **36**.

FIG. 4B illustrates a second detail view of a gobo holder of the invention when securing a gobo. As shown, the toothed portion **24** of the gobo holder extends parallel to the flange **26** around the circumference of the gobo holder. The gobo holder preferably has a narrow profile, which facilitates convenient removal from, and replacement in, the gobo wheel.

Referring now to FIGS. **1**, **2**, **3**, and **4**, in operation, very little work space is required to remove the gobo holder **22** from the gobo wheel **20**. Preferably, the entire gobo holder **22** is removed from the gobo wheel **20** when the corresponding gobo is to be replaced. The spring **48** in the gobo retainer **38** is removed to release the gobo. A new gobo is placed in the gobo retainer aperture against the land portion **44**. The spring **48** is again compressed between peripheral portions of the gobo and the gobo retainer overhang **45**.

When the gobo holder **22** is replaced into the baseplate, the toothed portion **24** re-engages the central sun gear **32**, and the gobo wheel is driven in the conventional manner. As may be appreciated, since the entire gobo holder **22** is removed from the gobo wheel, the replacement of the gobo from within the gobo holder is much more convenient, and likely faster, than in prior systems.

FIGS. **5A** and **5B** illustrate a gobo cooling system in accordance with the invention. A duct **52** channels air from an air forcing device (not shown), such as a fan, to an outflow opening **53** in the duct. The outflow opening **53** is directed to a transparent window **54**, which is placed in the light beam at an angle to the optical axis of the projector. The window **54** reflects the air onto the gobo **58** to cool the gobo. In the embodiment of FIG. **5A**, the ducting system is essentially closed. However, in other embodiments, as is illustrated in FIG. **5B**, the ducting system includes an additional opening **56**, offering cooling to other components in the system such as color filter wheels.

FIG. **5C** illustrates the cooling system of FIG. **5A** in a projector assembly. As discussed above, the projector includes a light source **65**, a gobo wheel **69**, and a light exit aperture **67**. The Air outflow of duct **61** is directed to a transparent window **63**, which is in the light path of the projector. The transparent window **63** directs the air onto the gobo wheel to cool a gobo **69**, which is also in the light path.

FIG. **6** illustrates an effect module **62** of the projector. The effect module **62** includes a baseplate with replaceable rotating holders **66** of a near identical design to the above described gobo holders. However, the holders **66** preferably contain optical distortion effects. The carousel is mounted so as to intercept the optical axis in same manner as the rotating gobo wheel of FIG. **1**. The wheel **62** is rotated to position the desired effect in the path of the light beam. The distortion effects may comprise such optical components as prisms, beam shapers, and other examples of lenticular lenses. Further to the effects, and forming another aspect of the present invention, is a variable frost filter **68**.

A graduated frost filter **68** is illustrated in FIG. **6**. The frost filter **68** is preferably provided along a portion of the periphery of the effects module **62**. The frost filter **68** is mounted adjacent to a clear aperture **64**, which allows for the passage of unadulterated light (0% frosting). The frost filter **68** is generally a transparent medium which has an unpolished surface. The degree to which this surface is roughened preferably determines the level of frosting for a projected beam. The frost filter **68** has light roughness around a first area **72(B)** generally near the clear opening **64**. The roughness of the filter increases as a function of angular displacement until reaching a heavy frost around a second area **70(A)**. Accordingly, when the frost filter **68** intercepts the light beam, the degree to which the image is frosted is varied by rotating the effects module **62**.

Although the present invention was discussed in terms of certain preferred embodiments, the invention is not limited to such embodiments. Rather, the invention includes other embodiments including those apparent to a person of ordinary skill in the art. Thus, the scope of the invention should not be limited by the preceding description but should be ascertained by reference to the claims that follow.

What is claimed is:

1. A rotatable gobo wheel assembly comprising:

a rotatable baseplate including at least one aperture formed therein;

a gobo holder including a first flange around a circumference of the gobo holder and a toothed flange spaced from the first flange, the gobo holder forming an opening therein;

a spring retainer coupled to the baseplate, the spring retainer adapted to removably couple to the first flange of the gobo holder to position the open portion of the gobo holder in the aperture; and

a center sun gear independently rotatable from the baseplate.

2. The gobo wheel assembly of claim **1**, wherein the gobo holder is positioned to hold a gobo in a beam of light, the gobo holder comprising:

a retainer for removably retaining a gobo there within, said retainer having first and second ends and being positioned in said beam of light such that light enters said retainer through said first end, passes through said gobo and exits said retainer through said second end, the retainer including a toothed portion along its outer circumference;

a bearing assembly coupled to said retainer, the bearing assembly further including a flange portion along its outer circumference adapted to couple to a spring retainer in a gobo wheel assembly, the bearing assembly allowing the retainer to rotate about a common axis relative to the flange portion in the bearing assembly outer circumference;

said retainer and bearing assembly including a cup-shaped member having an inner circumferential wall defining a cylindrical space, the first end having an annular land defining an aperture in the member and the second open end including an overhang; and

a resilient member removably mounted in the cylindrical space in a compressed position between the gobo and the overhang, whereby the gobo is removably retained adjacent the first end.

3. The gobo wheel assembly of claim **1**, wherein the bearing assembly of the gobo holder includes a plurality of bearings to provide for the relative rotation between the retainer and the flange portion.

4. The gobo wheel assembly of claim **1**, wherein the bearing assembly of the gobo holder includes a slide bearing to provide for the relative rotation between the retainer and the flange portion.

5. An optical element cooling system in a projector having a light source creating a light path within the projector, the projector including an optical element in the light path, comprising:

an air flow source coupled to an air ducting system in the projector, the ducting system directing air flow within the projector; and

a window provided in the ducting system along the light path from the light source, the window positioned at an angle to the air flow to deflect air in the direction of the optical element while substantially allowing all light to pass through the window.

6. The optical element cooling system of claim **5**, wherein the air ducting system includes an opening to provide a second air flow directed between a pair of optical elements.

7. The optical element cooling system of claim **5**, wherein the optical element is a gobo.

8. The optical element cooling system of claim **7**, wherein the window is positioned between the light source and the gobo.

9. An effects wheel in a light projector, comprising:

a rotatable baseplate having at least one aperture therein; and

a transparent frost filter having a roughened surface forming a portion of the baseplate angularly extending

from the aperture, the frost filter providing an angularly increasing frost effect from the aperture towards an angularly distant portion of the baseplate.

10. The effects wheel of claim 6 wherein the frost filter portion of the baseplate is a transparent element having a roughened surface, the surface roughness being at a minimum near the aperture and at a maximum near an angularly opposed end of the element.

11. A gobo carousel in a light projector having a light source and an exit aperture, the gobo carousel positioned between the light source and the exit aperture to place one of a plurality of gobos in the light path, the gobo carousel comprising:

a baseplate having a plurality of apertures spread radially along the baseplate surface, the apertures each defining an aperture circumference;

at least one spring retainer fixedly coupled to the baseplate, the spring retainer extending partially along the circumference of at least one of the apertures, the spring retainer provided substantially parallel to the baseplate in a spread apart configuration, the spring retainer adapted to removably hold a flange of a gobo holder; and

at least one gobo holder, the gobo holder including a flange along its outer circumference.

12. The gobo carousel of claim 11, wherein the at least one spring retainer is a conical spring.

13. The gobo carousel of claim 12, wherein the spring tapers to a minimum diameter that is greater than the diameter of the gobo holder.

14. A gobo wheel assembly in a light projector, comprising:

rotatable base means for rotatably placing one of a plurality of apertures in a light path of a projector;

gobo holder means for holding a gobo in which light entering the gobo holder means is passed through the gobo and exits the gobo holder means, the gobo holder means including flange means; and

spring retainer means for removably coupling said flange means on said gobo holder means, said gobo holder means being removably coupled to said rotatable base means.

* * * * *

Exhibit B

US006971770B2

(12) **United States Patent**
Rasmussen et al.

(10) **Patent No.: US 6,971,770 B2**
(45) **Date of Patent: Dec. 6, 2005**

(54) **LIGHTING APPARATUS**

(75) Inventors: **Niels Jorgen Rasmussen**, Arhus (DK); **Mads Glavind**, Hobro (DK)

(73) Assignee: **Martin Professional A/S**, (DK)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 182 days.

(21) Appl. No.: **10/236,606**

(22) Filed: **Sep. 6, 2002**

(65) **Prior Publication Data**

US 2003/0076681 A1 Apr. 24, 2003

Related U.S. Application Data

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(51) **Int. Cl.**[7] **F21V 9/00**

(52) **U.S. Cl.** **362/293**; 362/283; 362/284; 362/323; 362/324; 362/811

(58) **Field of Search** 362/293, 282, 362/283, 284, 322, 323, 324, 806, 811; 353/62, 353/80, 120

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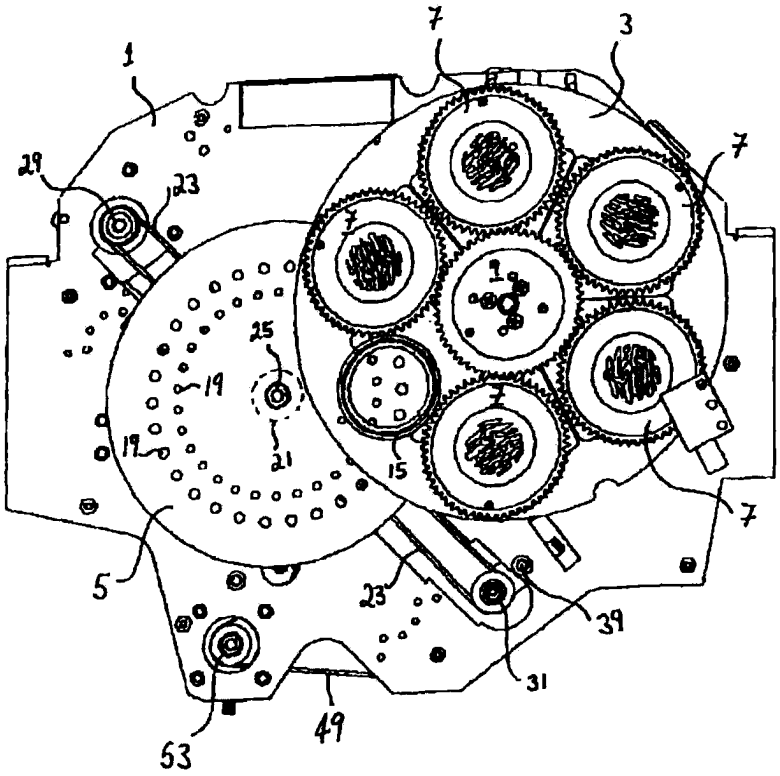
Primary Examiner—Stephen F Husar
(74) *Attorney, Agent, or Firm*—Skadden, Arps, Slate, Meagher & Flom LLP

(57) **ABSTRACT**

Lighting apparatus includes an effect wheel which is mounted on a rotation mechanism. The rotation mechanism is mounted on a mechanism which moves the effect wheel from a position outside of the light path to a position in which the effect wheel intersects the light path to provide a continuous wheel effect. The translation mechanism can move the effect wheel between positions in which the effect wheel crosses the light path in a horizontal direction and in a vertical direction, respectively. The apparatus allows a continuous wheel effect to be added to a multi-purpose luminaire and also allows the direction of travel of the continuous wheel effect across the illuminated field to be continuously varied.

14 Claims, 6 Drawing Sheets



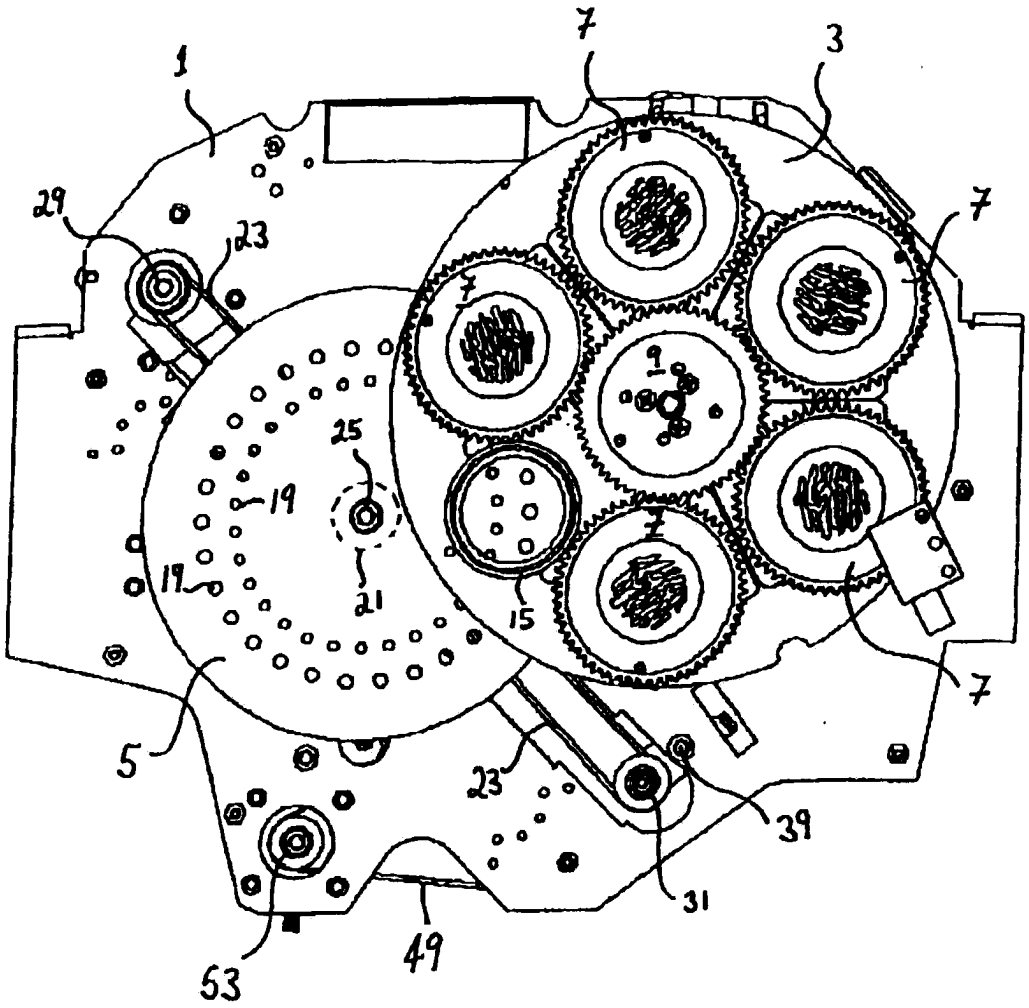


FIG. 1

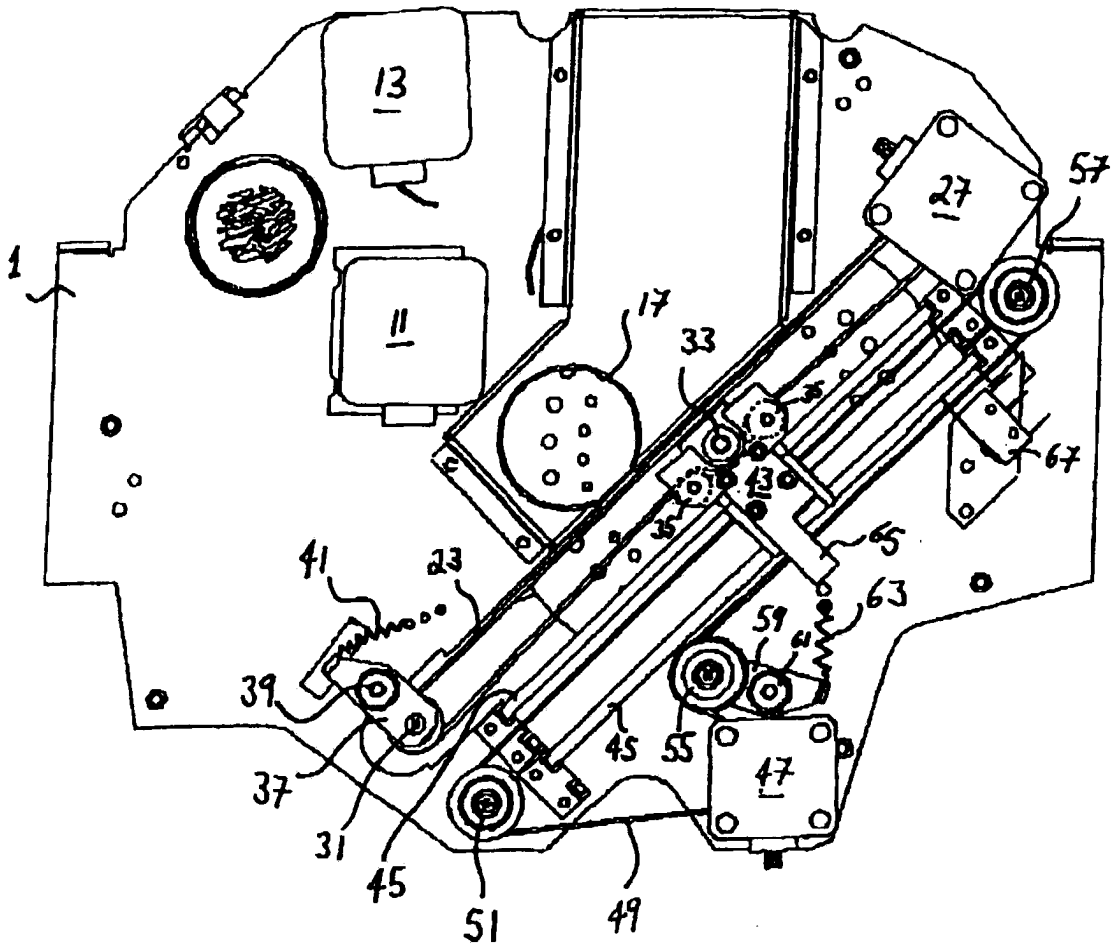


FIG. 2

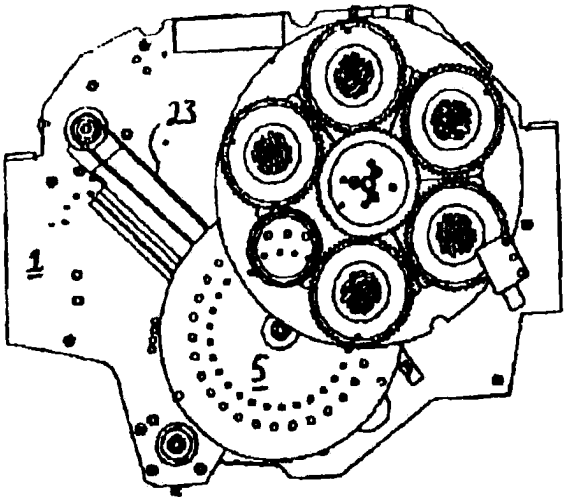


FIG. 3

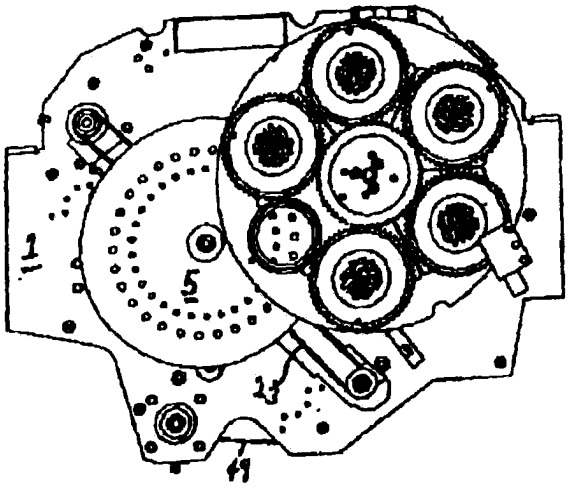


FIG. 4

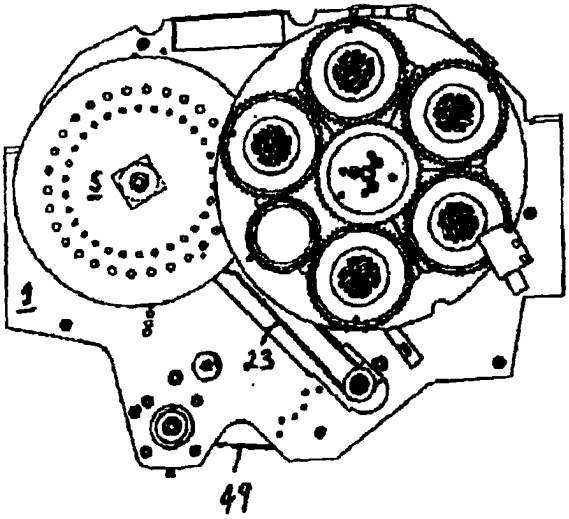


FIG. 5

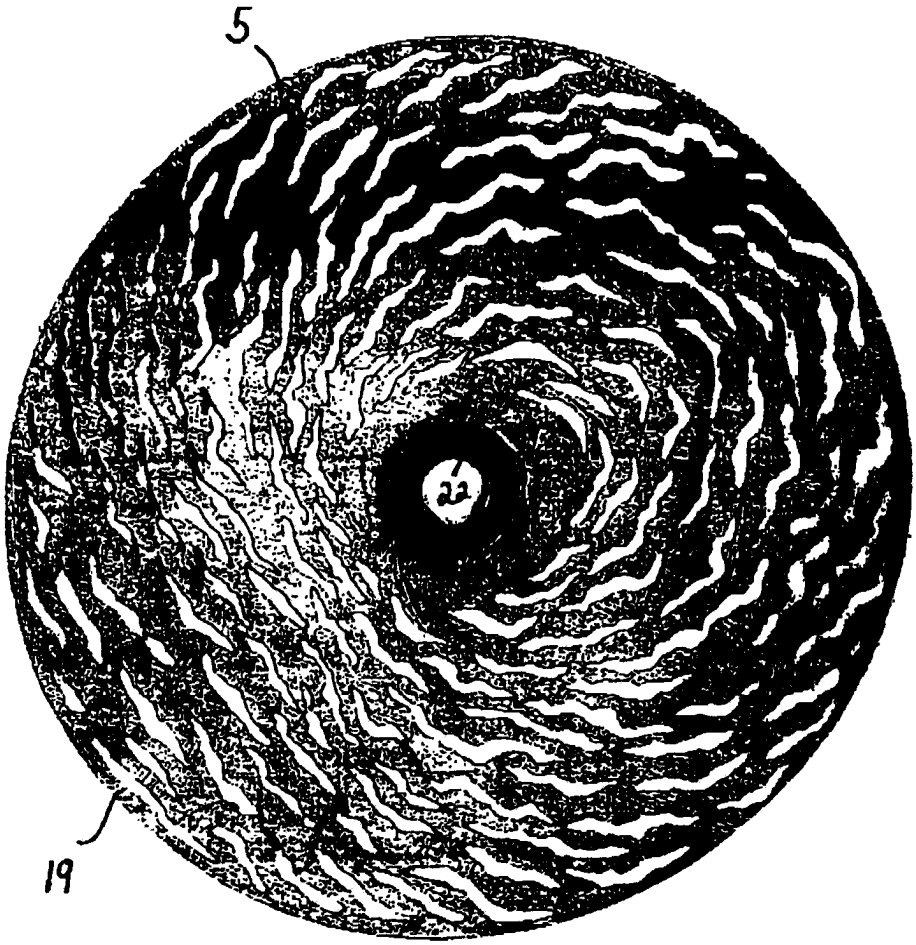


FIG. 6

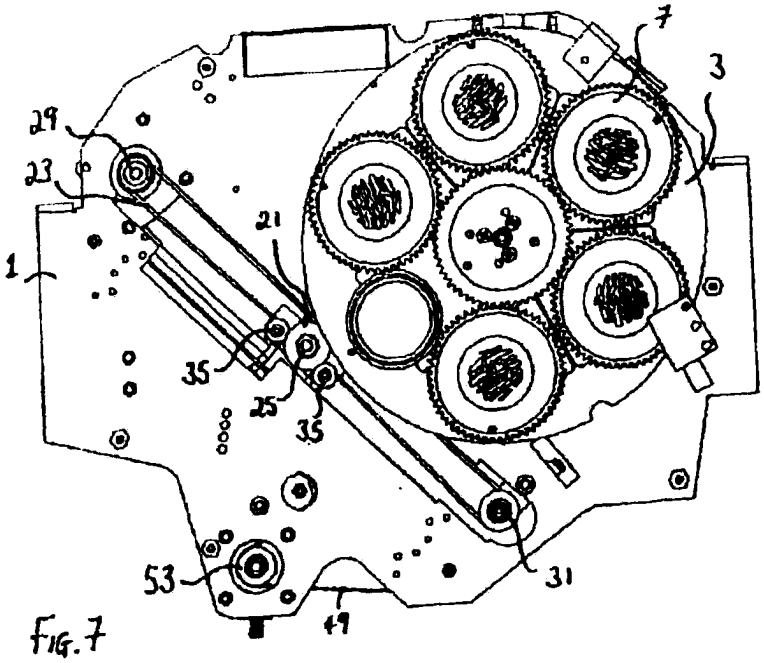


FIG. 7

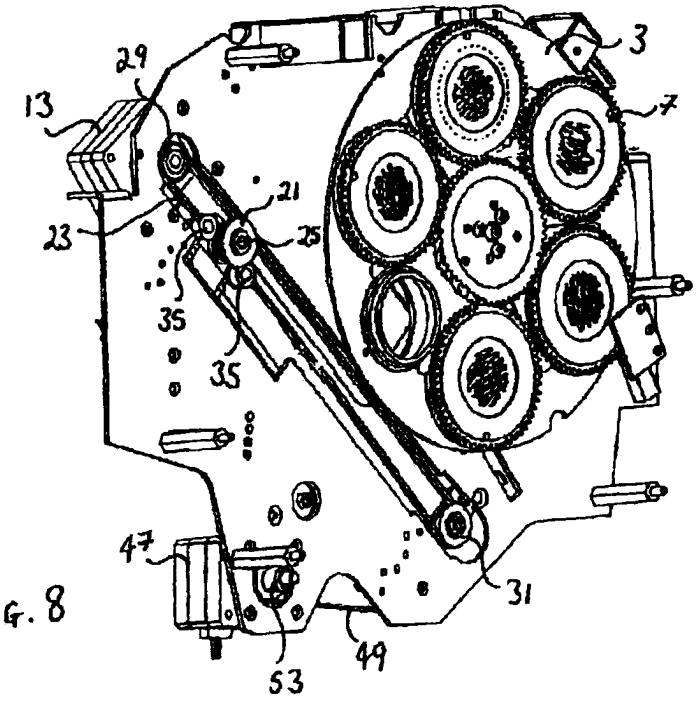


FIG. 8

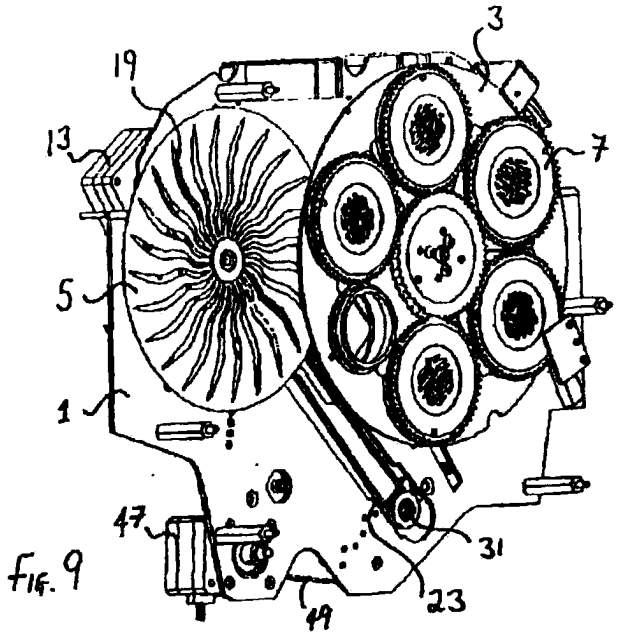


Fig. 9

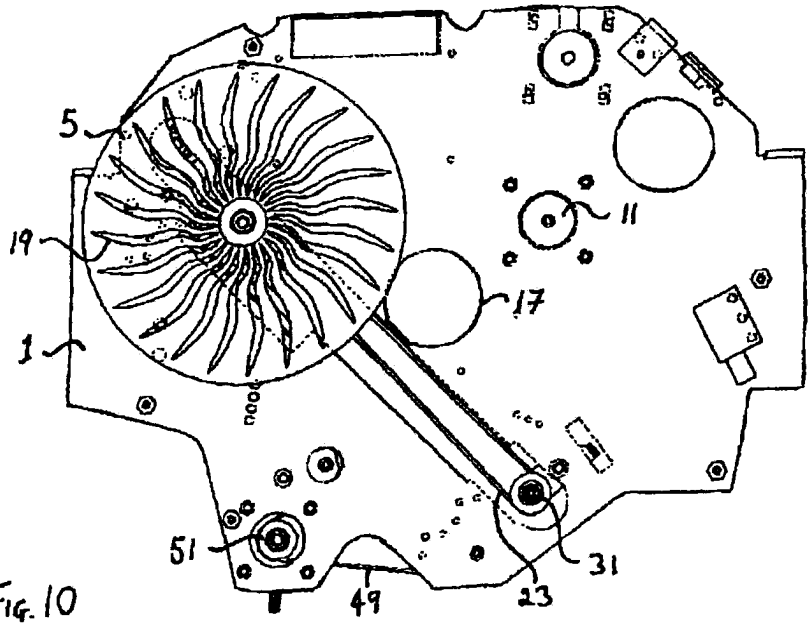


Fig. 10

LIGHTING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application Ser. No. 60,317,629, filed on Sep. 6, 2001.

FIELD OF THE INVENTION

The present invention relates to lighting apparatus and in particular to lighting apparatus for providing a continuous wheel effect.

BACKGROUND OF THE INVENTION

Theatrical lighting fixtures (or "luminaires") are used in theatres, nightclubs, concerts and the like to produce a wide variety of visual effects. An example of a multi-parameter lighting fixture is described in U.S. Pat. No. 4,392,187 to Bornhorst.

One type of effect is a continuous wheel effect, which is used in theatrical lighting to give animated visual effects reminiscent of, for example, passing clouds or flames. Traditionally, such an effect is produced by placing an appropriate rotating mask in front of a lamp with the center of the rotating mask outside of the beam of the lamp. A continuous wheel effect tends to be relatively static, apart from the rotation of the mask.

In general, the lighting apparatus may be in the form of a component for insertion into a luminaire, or other lighting fixture. The invention extends, therefore, to a luminaire comprising the lighting apparatus of the invention. The luminaire generally includes a light source, such as for example, a discharge lamp. The luminaire includes optical components, such as an elliptical reflector, arranged to direct light from a light source along the light path to the plane of the effect wheel. The luminaire includes one or more lenses, prisms, shutters and/or apertures arranged to direct light from the plane of the effect wheel out of the luminaire. The lighting apparatus may also include additional optical effects, such as gobos, color filters, prisms and the like.

SUMMARY OF THE INVENTION

Viewed from a first aspect, the invention provides lighting apparatus having a light path defined therethrough, comprising an effect wheel having a center and an effect region located radially outwardly of the center, the effect region being configured to alter the visual appearance of a light beam passing therethrough. The apparatus also includes a rotation mechanism arranged to rotate the effect wheel about the center. Finally, the apparatus includes a translation mechanism arranged to move the effect wheel between a first position in which the effect region is outside of the light path, and a second position in which the effect region intersects the light path and in which the center of the effect wheel is outside the light path.

Viewed from a further aspect, the invention provides a removable optical component for a lighting fixture including an optical portion adapted to alter the visual appearance of a light beam passing therethrough, a magnetic portion arranged to attach the optical component to a surface of a lighting fixture by magnetic attraction, and at least one locating formation configured to engage with a complementary locating formation on said lighting fixture to locate the optical component in position on said fixture.

Thus, according to this aspect of the invention, any optical component of a lighting fixture, such as a gobo, effect wheel, color filter or the like, can be attached easily in position by magnetic attraction.

In one embodiment, the complementary locating formations are mating pairs such as a projection and a complementary hole or recess, a rim and complementary ring, or any other suitable arrangement. The mating pairs are preferably arranged to prevent translational and/or rotational movement of the optical component relative to the lighting fixture. The invention also extends to a lighting fixture comprising such an optical component.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front view of an embodiment of the invention;

FIG. **2** is a rear view of the embodiment of FIG. **1**;

FIGS. **3** to **5** show the embodiment of FIG. **1** in three positions of use;

FIG. **6** shows an alternative effect wheel for use with the embodiment of FIG. **1**;

FIG. **7** is a front view of the embodiment of FIG. **1** with the effect wheel removed;

FIG. **8** is a perspective view of the embodiment of FIG. **1** in the position of FIG. **5** and with the effect wheel removed;

FIG. **9** is a perspective view of the embodiment of FIG. **1** in the position of FIG. **5** and with a further alternative effect wheel; and

FIG. **10** is a front view of the embodiment of FIG. **1** in the position of FIG. **5** with the gobo wheel removed and with the further alternative effect wheel.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** shows lighting apparatus according to an exemplary embodiment of the invention comprising a chassis **1** for mounting in a luminaire or other lighting fixture. Mounted to the chassis are a gobo wheel **3** and an effect wheel **5**. The gobo wheel **3** includes five removably mounted gobos **7**. Each gobo **7** has a toothed perimeter which engages with a central gobo drive wheel **9**. The gobo drive wheel **9** is rotated by a gobo drive wheel motor **11** (see FIG. **2**) to rotate each of the gobos **7**. A gobo wheel motor **13** (see FIG. **2**) is arranged to rotate the gobo wheel **3** by means of a belt (not shown) to align any selected gobo **7** with the light path of the luminaire.

The gobo wheel **3** includes a non-gobo aperture **15**, which allows light to pass unaffected through the gobo wheel **3**. In the position shown in FIG. **1**, the non-gobo aperture **15** of the gobo wheel **3** is aligned with the light path of the luminaire. A corresponding aperture **17** (see FIG. **2** and FIG. **10**) is defined in the chassis **1** to allow the passage of light from the light source of the luminaire.

The effect wheel **5** illustrated in FIG. **1** is an aluminum disc perforated with a circular pattern of holes **19**. The pattern of holes **19** shown on the effect wheel **5** in FIG. **1** is only one example of many such patterns which can be applied to effect wheels in accordance with the invention. An effect wheel **5** can be selected in accordance with the invention to provide projection effects which represent flame, clouds and other similar theatrical effects. Exemplary alternative effect wheels are shown in FIG. **6** and FIGS. **9** and **10**.

In one embodiment, the lighting apparatus includes a chassis, for example in the form of a plate, to which the

effect wheel, the rotation mechanism and/or the translation mechanism is mounted. The chassis can include an aperture which controls, at least partially, the light path through the apparatus. The plane of the effect wheel is preferably substantially perpendicular to the light path, at least when the effect wheel is in the second position. In this way, uniform focus of the effect wheel can be achieved.

In general, the effect wheel is circular, for example, in the form of a disc. However, in other embodiments, the effect wheel has other regular or irregular shapes. For example, the effect wheel can be square, hexagonal, or any other polygonal shape. Alternatively, the effect wheel can be star-shaped, flower-shaped, cloud-shaped, or take the form of a spoked wheel. In yet another embodiment, the effect wheel is an oil wheel comprising one or more liquids, such as oil, sealed between two transparent plates, or discs. As may be appreciated, the configuration of the effect wheel is determined predominantly by the visual effect that it is desired to produce.

In one embodiment, the effect wheel is substantially flat and of substantially constant thickness over its extent. However, in other embodiments the effect wheel is contoured, as required to produce a desired visual effect. Similarly, the thickness of the effect wheel can vary over its extent. For example, the effect region may be composed of transparent material and the desired visual effect is achieved by variations in the thickness of the material.

In one arrangement, the effect wheel is in the form of a disc of glass or other transparent material having a reflective, for example dichroic, coating thereon. In this embodiment, the coating is etched away to define a desired pattern.

The center of the effect wheel is the point about which the effect wheel is rotated by the rotation mechanism. The center is preferably substantially the center of mass or the centroid of the effect wheel. Alternatively, the center can be spaced from the geometrical center of the effect wheel, particularly where the shape of the effect wheel is irregular. The center preferably includes a mounting location for the effect wheel to the rotation mechanism. Alternatively, the center can simply be a notional point where the axis of rotation of the effect wheel intersects the plane of the effect wheel.

In one embodiment, the effect region may extend over substantially the entire surface of the effect wheel. Alternatively, the effect region is in the form of a ring of sufficient width to cover the light path when the effect wheel is in the second position. In some embodiments, the effect region may have an angular extent of less than 360 degrees about the center of the effect wheel, for example where a cyclical visual effect is desired. The composition of the effect region is determined predominantly by the visual effect to be produced. In a simple embodiment, the effect region is in the form a mask (or gobo) having holes defined therein to allow light to pass through in a predetermined pattern. Rotating masks of this type for providing a continuous wheel effect, for example to give the impression of clouds or fire are well known in theatrical lighting. The effect region may include, alternatively or in addition to masking, color filters, frosting, prisms or any other desired optical effect.

The size of the effect wheel and/or the effect region relative to the cross-sectional area of the light path is preferably sufficiently large so that the projected effect gives an impression that the effect region is crossing the light path in a substantially linear, rather than circular, path. Thus, in the second position, the distance between the center of the effect wheel and the center of the light path is desirably greater than half the maximum cross-sectional width of the light path. In another embodiment, this distance is greater than the maximum cross-sectional width of the light path. In yet another embodiment, this distance is greater than one and a half times the maximum cross-sectional width of the light path.

Hence, in this embodiment, the width (diameter) of the effect wheel is at least twice the maximum cross-sectional width of the light path. In other embodiments, the width (diameter) of the effect wheel increases to at least three or four times the maximum cross-sectional width of the light path.

The apparatus of the invention can be used to provide a continuous wheel effect, for example to give the impression of clouds or fire in theatrical lighting, when the effect wheel is in the second position. However, the effect wheel can be moved into the first position when the continuous wheel effect is not required so that the luminaire, or other lighting fixture in which the apparatus may be mounted, can additionally be used for other lighting effects.

The luminaire preferably includes a light source such as, for example a discharge lamp. The luminaire also includes optical components, such as an elliptical reflector, arranged to direct light from a light source along the light path to the plane of the effect wheel. The luminaire further includes one or more lenses, prisms, shutters and/or apertures arranged to direct light from the plane of the effect wheel out of the luminaire. Optionally, the lighting apparatus may comprise additional optical effects, such as gobos, color filters, prisms and the like.

The effect wheel **5** is mounted on a drive disc **21** (see FIGS. **7** and **8**) which is rotated by means of a first belt **23** as described in detail below. The effect wheel **5** is fixed to the drive disc **21** by means of a washer **22** of magnetic material which is bonded to the effect wheel **5** about its center (see FIG. **6**). The washer **22** holds the effect wheel **5** to the ferrous drive disc **21** by magnetic attraction. The provision of a magnetic washer **22** allows for simple and rapid interchange of effect wheels **5**. The effect wheel **5** is located centrally on the drive disk **21** by a central protuberance **25** which passes through a complementary aperture in the effect wheel.

Referring now to FIG. **2**, the first belt **23** is driven by a rotation motor **27**. The first belt **23** passes around a first drive pulley **29** (see FIG. **1**), around a first tensioning pulley **31** and past a drive shaft **33** of the drive disc **21**. The first belt **23** is a toothed belt which is keyed to the first drive pulley **29** and to the drive shaft **33**. The first belt **23** is held against the drive shaft **33** by two guide rollers **35** (see FIGS. **7** and **8**). The first tensioning pulley **31** is located at a distal end of a first tensioning arm **37** which is arranged to pivot about a first pivot **39**. The first belt **23** is tensioned by the action of a first tension spring **41** which is connected between a proximal end of the first tensioning arm **37** and the chassis **1**.

In operation, when the rotation motor **27** is activated, the rotation of the first drive pulley **29** is transmitted by the first belt **23** to rotate the drive shaft **33**, the drive disc **21** and thus the effect wheel **5**. The drive disc **21**, drive shaft **33** and guide rollers **35** are all mounted on a carriage **43**, which itself is slidably mounted on two parallel guide bars **45**. The guide bars **45** confine the carriage **43** to move along a linear path at an angle of about 45° to the horizontal (or vertical) and parallel to the plane of the chassis **1**. Consequently, the center of the effect wheel **5** is also moved along a parallel path.

The carriage **43** is driven along the guide bars **45** by a position motor **47** via a second belt **49**. The second belt **49** is clamped within the carriage **43**. The second belt **49** passes

from the carriage **43** around a first free pulley **51**, a second drive pulley **53** driven by the position motor **47**, a second tensioning pulley **55**, and around a second free pulley **57** back to the carriage **43**. The second belt **49** is a toothed belt which is keyed to the second drive pulley **53**. The second tensioning pulley **55** is mounted at the distal end of a second tensioning arm **59** which is pivotally mounted on a second pivot **61**. The second belt **49** is tensioned by the action of a second tension spring **63** on a proximal end of the second tensioning arm **59**. The carriage **43** includes a projection **65** which engages with and actuates a sensor switch **67** when the carriage **43** is at the proximal end of the guide bars **45**.

As shown in FIG. **3**, when the carriage **43** is at the distal end of the guide bars **45**, the center of the effect wheel **5** is substantially directly vertically below the light path through the aperture **17** of the chassis **1**. Consequently, rotation of the effect wheel **5** by means of the rotation motor **27** and the first belt **23** causes the circular pattern **19** to cross the light path in a substantially horizontal direction.

When the effect wheel is moved to the position shown in FIG. **4** (and FIG. **1**) by means of the position motor **47** and the second belt **49**, the center of the effect wheel **5** is at substantially the same horizontal level as the light path through aperture **17** of the chassis **1**. Consequently, rotation of the effect wheel **5** by means of the rotation motor **27** and the first belt **23**, causes the circular pattern **19** on the effect wheel **5** to cross the light path in a substantially vertical direction.

By means of the position motor **47**, the effect wheel **5** may be moved to a position intermediate the positions shown in FIGS. **3** and **4** to provide movement of the circular pattern **19** through the light path in any direction between the horizontal and the vertical. Furthermore, the linear movement of the effect wheel **5** may be used creatively as part of the effect. For example, the position motor **47** may be actuated cyclically to effect continuous variation of the direction of motion of the circular pattern **19** on the effect wheel **5**.

As shown in FIG. **5** (and FIGS. **9** and **10**), when the effect wheel **5** is moved to the proximal end of the guide bars **45**, the effect wheel **5** no longer intersects the light path through the aperture **17** of the chassis **1**. Thus, the effect wheel **5** can reside in this position in a luminaire without affecting the other visual effects which may be used in the luminaire, for example gobo wheel **3**, until the continuously rotating wheel effect of the effect wheel **5** is required. When the effect wheel **5** is at the very proximal end of the guide bars **43**, the engagement of the projection **65** on the carriage **43** with the sensor switch **67** actuates the sensor switch **67** to provide a confirmatory signal that the effect wheel **5** is outside of the light path for calibration of the position of the carriage **43** on initialization of the apparatus.

In one embodiment, the translation mechanism is arranged to move the effect wheel to a third position in which the effect region intersects the light path and the center of the effect wheel is outside the light path. In the third position, a radius through the light path from the center of the effect wheel is substantially perpendicular to a radius through the light path from the center of the effect wheel in the second position. According to this arrangement, the effect wheel can be moved from the second position to a third position and in doing so the apparent direction of travel of the effect region past the light path is rotated through a right angle (90 degrees). The ability to rotate the direction of travel of the effect region, i.e. a tangent to the center of the effect wheel crossing the light path, while the continuous wheel effect is operating provides creative lighting possibilities which have not previously been available.

Desirably, the translation mechanism is arranged to move the effect wheel to at least one position intermediate the second and third positions. Most desirably, the translation mechanism is arranged to move the effect wheel to any position intermediate the second and third positions. In one arrangement, the first, second and third positions are collinear. The second position may be located between the first and third positions. The translation mechanism may be any suitable mechanism. In general, the translation mechanism includes an electric motor, which allows for electronically controlling the translation of the effect wheel.

In another embodiment, the translation mechanism moves the effect wheel from one position to another position along a circular path. For example, the effect wheel may be mounted on a pivot arm (or wheel) and the electric motor may cause the arm (or wheel) to rotate about an axis in order to move the effect wheel from the one position to another.

The translation mechanism is preferably configured to move the effect wheel linearly from position to position. Thus, the translation mechanism includes a linear guide arrangement and a carriage mounted for linear movement along the guide arrangement. The effect wheel is mounted on the carriage for movement therewith. The guide arrangement includes, for example, one or more guide bars, guide tracks, or guide slots.

In one embodiment, the guide arrangement includes a threaded bar received within a complementary threaded hole in the carriage such that rotation of the threaded bar by the electric motor causes linear movement of the carriage.

In an exemplary embodiment, the carriage is driven along the guide arrangement by a belt element attached to the carriage. The belt element includes belts, chains, strings, and wires.

The rotation mechanism is preferably any suitable mechanism for facilitating the desired movement. In general, the rotation mechanism includes an electric motor, which allows for electrically controlling the rotation of the effect wheel.

In one embodiment, the electric motor is connected directly to the effect wheel. However, in a preferred embodiment the electric motor is fixed relative to the light path and the rotation mechanism comprises a transmission arrangement transmitting the rotational movement of the electric motor to the effect wheel, at least in the second position. The transmission arrangement is preferably arranged to engage the electric motor and/or the effect wheel when the effect wheel is in the second position. However, in the exemplary arrangement, the transmission arrangement is engaged with the electric motor and the effect wheel in the first position and in the second position.

In some embodiments, the transmission arrangement includes a gear train or the like. However, in the exemplary arrangement, the transmission arrangement comprises a belt, as defined herein. In one embodiment, the belt is arranged as a loop between a drive pulley, driven by the electric motor, and a tensioning pulley. A driven pulley engages the belt between the drive pulley and the tensioning pulley and imparts rotational movement to the effect wheel. This arrangement has the advantage that the driven pulley can move linearly along the belt loop while maintaining contact with the belt. Desirably the driven pulley is mounted on the carriage described above.

In one embodiment, the rotation mechanism is configured to engage an edge of the effect wheel to impart rotational movement thereto. However, in a preferred embodiment, the center of the effect wheel is connected to a driven member

of the rotation mechanism for rotation therewith. For example, the driven member can be the driven pulley described above.

Desirably, the effect wheel is removable mounted on the rotation mechanism. For example, the effect wheel may be clipped, screwed or otherwise removably attached. In an exemplary arrangement, the effect wheel is magnetically attached to the rotation mechanism. The rotation mechanism preferably includes a locating formation configured to engage with a complementary locating formation on the effect wheel to locate the effect wheel in position on the rotation mechanism. Magnetic attachment of the effect wheel to the rotation mechanism allows the effect wheel to be replaced easily, because the magnetic attraction of the effect wheel to the rotation mechanism tends to pull the effect wheel into position until the locating formations engage. In this way, effect wheels can be exchanged easily in a narrow space in a luminaire. The width of components in a luminaire is kept to a minimum in order to minimize the inertial momentum of the fixture to allow rapid movement.

It will be appreciated from the foregoing that the invention provides a compact and convenient configuration of a continuous wheel effect which can be inserted into a known luminaire, such as the MAC 2000 Profile available from Martin Professional AS. Furthermore, the invention provides the opportunity to produce effects which have not previously been available using a simple continuous rotating wheel.

In summary, lighting apparatus includes an effect wheel which is magnetically mounted on a rotation mechanism. The rotation mechanism is mounted on a translation mechanism which moves the effect wheel from a position outside of the light path to a position in which the effect wheel intersects the light path to provide a continuous wheel effect. The translation mechanism can move the effect wheel between positions in which the effect wheel crosses the light path in a horizontal direction and in a vertical direction, respectively. The apparatus allows a continuous wheel effect to be added to a multi-purpose luminaire and also allows the direction of travel of the continuous wheel effect across the illuminated field to be continuously varied.

Although the present invention was discussed in terms of certain preferred embodiments, the invention is not limited to such embodiments. A person of ordinary skill in the art will appreciate that numerous variations and combinations of the features set forth above can be utilized without departing from the present invention as set forth in the claims. Thus, the scope of the invention should not be limited by the preceding description but should be ascertained by reference to claims that follow.

What is claimed is:

1. A lighting apparatus having a light path defined therethrough, comprising:

an effect wheel having a center and an effect region located radially outwardly of the center, the effect region being configured to alter the visual appearance of a light beam passing therethrough;

a rotation mechanism arranged to rotate the effect wheel about the center; and a translation mechanism arranged to move the effect wheel between

a first position in which the effect region is outside of the light path, and

a second position in which the effect region intersects the light path and in which the center of the effect wheel is outside the light path

(iii) a third position in which the effect region intersects the light path and in which the center of the effect wheel is outside the light path and wherein a radius through the light path from the center of the effect wheel in the third position is substantially perpendicular to a radius through the light path from the center of the effect wheel in the second position.

2. The lighting apparatus of claim **1**, wherein the translation mechanism is arranged to move the effect wheel to any position intermediate the second and third positions.

3. The lighting apparatus of claim **1**, wherein the first, second and third positions are collinear.

4. The lighting apparatus of claim **1**, wherein the translation mechanism is configured to move the effect wheel linearly from one said position to another said position.

5. The lighting apparatus of claim **1**, wherein the translation mechanism comprises a linear guide arrangement and a carriage mounted for linear movement along the guide arrangement, and the effect wheel is mounted on the carriage for movement therewith.

6. The lighting apparatus of claim **1**, wherein the translation mechanism includes an electric motor.

7. The lighting apparatus of claim **1**, wherein the rotation mechanism includes an electric motor.

8. The lighting apparatus of claim **7**, wherein the electric motor is fixed relative to the light path and the rotation mechanism comprises a transmission arrangement arranged to transmit rotational movement of the electric motor to the effect wheel.

9. The lighting apparatus of claim **8**, wherein the transmission arrangement comprises:

a belt arranged in a loop between a drive pulley driven by the electric motor and a tensioning pulley, wherein

a driven pulley engages the belt between the drive pulley and the tensioning pulley and is arranged to impart rotational movement to the effect wheel.

10. The lighting apparatus of claim **1**, wherein the center of the effect wheel is connected to a driven member of the rotation mechanism for rotation therewith.

11. The lighting apparatus of claim **1**, wherein the effect wheel is removable mounted on the rotation mechanism.

12. The lighting apparatus of claim **4**, wherein the effect wheel is magnetically attached to the rotation mechanism.

13. A luminaire comprising the lighting apparatus of claim **1**.

14. A lighting apparatus having a light path defined therethrough, comprising:

an effect wheel having a center and an effect region located radially outwardly of the center, the effect region being configured to alter the visual appearance of a light beam passing therethrough the effect region of said effect wheel includes a removable optical component comprising:

an optical portion adapted to alter the visual appearance of a light beam passing therethrough;

a magnetic portion arranged to attach the optical component to a surface of the effect wheel by magnetic attraction; and

at least one locating formation configured to engage with a complementary locating formation on said effect wheel to locate the optical component in position on said effect wheel;

a rotation mechanism arranged to rotate the effect wheel about the center; and

a translation mechanism arranged to move the effect wheel between

a first position in which the effect region is outside of the light path, and

a second position in which the effect region intersects the light path and in which the center of the effect wheel is outside the light path.

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